

REMARKS

Claims 1-10 are pending in the application. Claims 1-3 and 9 are rejected. Claims 6 and 10 are allowed. Claims 4, 5, 7 and 8 are withdrawn from consideration. Claim 1 is amended. New claim 11 has been added.

Drawings

The drawings are again objected to under 37 C.F.R. § 1.83(a) because they do not show every feature of the invention specified in the claims. Specifically, the Examiner asserts that "inlet having a diameter that is slightly greater than the diameter of a flat bottom face of the valve body, the flat bottom face being positioned within the inlet" is asserted to be missing. Notwithstanding Applicants argument that the feature is expressly taught at page 5, lines 4-6 and is, in fact, disclosed by virtue of the illustration in Fig. 2 in combination with the text at page 5, the Examiner asserts that the recitation that the flat bottom face is positioned within the inlet is not seen in Fig. 2.

Applicants understand the Examiner's position that the recitation that the diameter of the inlet is slightly greater than the diameter of the flat bottom face 32b is not precise in the Figures. The Examiner asserts that this is a critical feature and must be shown.

Applicant proposes to add an amended Fig. 2 in which the diameter of inlet (7b) is slightly greater than the diameter of the 15 bottom flat surface (32b) of the ball shaped valve body 32. Applicants have not attempted to add the Figure formally, until the Examiner confirms that there is no new matter issue involved. In this regard, Applicants respectfully submit that the overall teaching of the original disclosure and claims, as well as original Figure 2, would lead one skilled in the art to the structure that is presented in proposed amended claim 2. Applicant will submit this figure formally upon approval by the Examiner. The undersigned is prepared to discuss this with the Examiner by telephone or in a personal interview, if desired.

Claim Rejections - 35 U.S.C. § 103

Claims 1, 2, 3 and 9 are rejected under 35 U.S.C. §103(a) as being unpatentable over Peterson, Jr. (6,769,625) in view of Ono (JP 59-128968). This rejection is traversed for at least the following reasons.

Peterson

The Examiner again presents an analysis of claims 1 and 9 which compares the structure of the claims to the teachings of Peterson, particularly Figs. 2A and 2B. In particular, the Examiner points to the valve seat face 134(a), valve body 126, injection port 135, nozzle plate 10 with holes 142, and a fuel passage 146 having a cross section as claimed.

The Examiner admits that Peterson does not disclose a flat bottom face on the illustrated valve body, nor a ball portion having a diameter smaller than the inlet, such that the valve body is positioned within the inlet when the valve body is closed. Further, Peterson does not disclose a plurality of flat portions circumferentially disposed on the ball and adapted to engage a surface of the valve seat face.

Ono

The Examiner looks to Ono for a disclosure of a fuel injector having a valve body, comprising a plunger 6 that is coupled to a ball 7 and is biased to have the ball 7 close a seat face 21 that leads to a nozzle 19. The Examiner asserts that the ball 7 has a portion with a flat bottom face that is positioned within an inlet, particularly as illustrated in Fig. 2. The Examiner asserts it would have been obvious to one of ordinary skill in the art to substitute the valve body of Peterson with the flat bottom ball of Ono in order to provide a more effective fuel injector.

Applicants submit that the cited art does not teach the further limitations added to claim 1 and that, in any event, the two references are incompatible.

New Limitations

As to the new limitations, Applicants have defined the ball in claim 1 as having plural flat portions 32a disposed circumferentially on the surface of the ball, as illustrated in Fig. 1. The surfaces are adapted to engage the surface of the valve seat face. Applicants submit that these flat faces help to accurately locate the ball within the seat, which itself has a conical shape, particularly as illustrated in Fig 1.

Further, Applicants note that Peterson teaches that the fuel passages are shaped as a cone having a diameter that gradually and continuously increases away from the outlet of the injection

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port, as illustrated in Figs. 2A and 2B. However, the interface between the ball 126a and the seat surface in Pederson is primarily at the perimeter of the opening of the fuel passage and makes a line contact, as taught at col. 4, lines 56-65. As Applicants previously asserted, a greater surface area is in contact with the present invention, thereby providing greater sealing capacity, as illustrated in Fig. 2. This offers a significant distinction in performance. Applicants have added new claim 11, which depends from claim 2 and specifies that the contact between the seat and ball is greater than a line contact.

Incompatibility of the References

As to the incompatibility of Peterson and Ono, it may be noted that Peterson uses a guide member 127 which has fuel holes 127a, 127b therein and through which the ball 126a appears to pass, while Ono has no such guide member.

In the Ono reference, fuel enters the top cover (29) and passes through an interval envelop (8), a central passage (30) within plunger (6), and enters the valve chamber ('fuel chamber) (18) via a cutout (31) of a tip of plunger (6). In the state of Figs. 1 and 2 of the Ono Patent, the solenoid coil (3) is not biased, a spring force of spring (9) contacts under pressure with the seat surface (21) so that the valve is closed and the fuel injection is stopped. If solenoid coil (3) is biased, the plunger (6) is moved in the rightward direction so that a ball surface (17) of the stopper is brought in contact with truncated cone surface (15) and is stopped. At the same time of the rightward movement of the plunger (6), the ball (7) is separated from seat surface (21) and fuel of a predetermined quantity is injected from the nozzle (19) via the gap provided therebetween. Then, the solenoid is de-energized, the ball (7) is contacted with the 15 seat surface (21) , and the fuel injection is stopped. The above-operation is repeated so that the predetermined quantity of fuel is injected.

It is emphasized that the Ono reference does not disclose a plurality of nozzle holes (8a, 22a, 31a) at a downstream side of the injection hole, as recited in the claim 1 of the present application. In addition, the structure of the nozzle plate described in the claim 1 is not found in the Ono reference.

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Applicants respectfully submit that a provision of a plurality of nozzle holes in the nozzle part (19) of the Ono reference (Fig. 2) is physically impossible. The physical structure of Fig. 2 of Ono precludes such arrangement. Thus, even though Peterson teaches the use of a plurality of nozzle holes, there is no possibility that they could be added mechanically to the arrangement in Ono.

In addition, Ono discloses a guide pipe (5) in Fig. 2, but the guide pipe in Ono does not function in the same manner as the guide member 127 in Paterson.

As to claim 3, the Examiner finds the inlet to be shaped like the frustum of a cone, as in Figs. 2A and 2B of Pederson. Claim 3 would be patentable for reasons given with respect to claim 2.

Finally, Applicants submit that all other claims, including the withdrawn claims, would be allowable due to their dependence on claim 1.

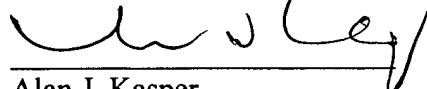
Allowable Subject Matter

Applicants note with appreciation that claims 6 and 10 are allowed.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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